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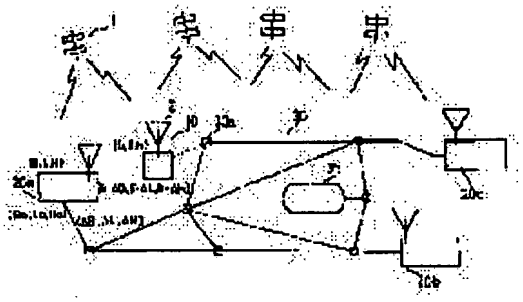
(54) INFORMATION PROCESSING APPARATUS AND POSITION INFORMATION PROVIDING SYSTEM

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an information processing apparatus which corrects the position information measured by GPS measurement based on error information and makes DGPS(differential GPS) to obtain highly precise position information economically usable and to provide a position information providing system.
SOLUTION: An information processing terminal 10 is provided with a function for the access to the internet additionally to a GPS measurement function, so that the error information for DGPS obtained by a fixed standard station 20 can be supplied to the information processing terminal 10 through the internet 30. Since the access to the internet 30 can be done various kinds of communication media usable for the information processing terminal 10, it is no need to constitute a communication system to provide the error information and an environment to use the DGPS extremely economically can be constituted.



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INFORMATION PROCESSOR AND SYSTEM THAT OFFERS POSITION INFORMATION
[Joho shori sochi oyobi ichi joho teikyo shisutemu]

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(Claims) /2

(Claim 1) Information processor so characterized that it has a position information acquisition means that can acquire its own position information based on data received from several satellites;

an access means that can connect by way of a computer network to a service system that offers error information on the above-mentioned position information, and;

a position information correction means that transmits the above-mentioned position information to the above-mentioned service system, receives error information for correcting the above-mentioned position information, and corrects the above-mentioned position information.

(Claim 2) Information processor so characterized that it has a position information acquisition means that can acquire its own position information based on data received from several satellites;

an access means that can connect by way of a computer network to a service system that offers error information on the above-mentioned position information, and;

a position information correction means that transmits the above-mentioned position information to the above-mentioned service system and receives the above-mentioned position information after correcting.

(Claim 3) Information processor so characterized that in Claim 1 or 2, the above-mentioned access means can connect to a map information service system that offers map information by way of a computer network, and furthermore,

it has a map information acquisition means that acquires map

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* Numbers in the margin indicate pagination in the foreign text.

information for the region pertaining to the above-mentioned corrected position information from the above-mentioned map information service system based on the above-mentioned corrected position information.

(Claim 4) Information processor so characterized that in Claim 1 or 2, the above-mentioned computer network is the Internet.

(Claim 5) Information processor control method so characterized that it is a control method for an information processor that has a position information acquisition means that can acquire its own position information based on data received from several satellites and an access means that can connect by way of a computer network to a desired service system, and it has:

a step that acquires the above-mentioned position information by the above-mentioned position information acquisition means;

a step that connects by the above-mentioned access means to the above-mentioned service system and offers error information on the above-mentioned position information;

a step that transmits the above-mentioned position information to the above-mentioned service system, and;

a step that receives error information for correcting the above-mentioned position information or corrected position information from the above-mentioned service system.

(Claim 6) System that offers position information so characterized that it is a system offering position information that receives data showing position information from several satellites and can acquire error information on the above-mentioned position information from several fixed base stations that can offer the above-mentioned error information by comparing it to its own preascertained reference

position, and it has:

a means that stores the above-mentioned error information from the above-mentioned fixed base stations as reference error information;

a means that receives the above-mentioned position information of the user by way of a computer network, and;

a position information offering means that selects or processes the error information that applies to the above-mentioned user position information from the above-mentioned reference error information and transmits this to the above-mentioned user by way of the above-mentioned computer network.

(Claim 7) System that offers position information so characterized that it is a system offering position information that can acquire error information on position information from several fixed base stations that can offer the above-mentioned error information by receiving data showing the above-mentioned position information from several satellites and comparing it to its own preascertained reference position, and it has:

a means that stores the above-mentioned error information from the above-mentioned fixed base stations as reference error information;

a means that receives the above-mentioned position information of the user by way of a computer network, and;

a position information offering means that finds the error information that applies to the above-mentioned user position information from the above-mentioned reference error information and corrects the above-mentioned user position information, then transmits this to the above-mentioned user by way of the above-mentioned computer network.

(Claim 8) System that offers position information so characterized that in Claim 6 or 7, the above-mentioned computer network is the Internet.

(Claim 9) System that offers position information so characterized that in Claim 6 or 7, it has a map information offering means that transmits map information based on the above-mentioned user position information and its error information to the above-mentioned user by way the above-mentioned computer network.

(Detailed Description of the Invention)

(Industrial Field of Application) This invention pertains to an information processor such as a computer that can acquire position information, and to a system that can offer information regarding position to an information processor.

(Prior Art) Systems have been developed that can detect their own position by receiving radio waves from several satellites. For example, GPS (Global Positioning System) is used in systems such as automotive car navigation systems. In a normal system, the precision of the position obtained when a processing terminal housing this GPS measures only its own position is about 100 m. As one method for improving the precision of position information in systems that detect this type of position, there is the method of correcting using error information (difference information) by having a base station the position of which has been preascertained with good precision compare position information obtained by GPS with the known reference position information of this base station. In GPS, this is called DGPS (difference GPS). /3

(Problems that the Invention is to Solve) For a terminal that houses GPS to find its own position information with good precision by

the DGPS system when its own position is not ascertained, it must receive data from satellites and apply computation processing to acquire error information at that point. The error information used in computation processing fluctuates depending on the region and time. As a result, for a terminal housing GPS to compute the position of the location of this terminal with good precision, it must acquire error information obtained near this location at roughly the same time. Because data from satellites are data that show location, these are found by a GPS antenna attached to the terminal. In addition, methods that have been considered as means for acquiring error information include the method of transmitting error information from a base station by radio waves such as FM waves, and the method of transmitting error information using a PHS base station as the base station as described in Japan Kokai Patent No. 8-36044.

However, these methods require that base stations be located where they can transmit error information to all terminals —that is, in all regions—, and so require setting up countless base stations throughout the world. Therefore, mammoth expense is required to equip an environment so that DGPS can be used everywhere. Moreover, even if such an environment is equipped, a terminal that has GPS must have a receiving function for acquiring error information in addition to the function that receives data from satellites, and this receiving function must have several systems besides GPS for processing such as selecting the base station that obtains the most appropriate error information from countless base stations. Furthermore, when error information is transmitted by way of communication media that differ for each region such as FM waves or PHS, unless the terminal obtains error information

by a medium that conforms to this region, DGPS cannot be used, and a universal information processing terminal that can be used anywhere cannot be realized.

Therefore, the purpose of this invention is to offer an information processor, control method, and system that offers position information that can use error information for position information by a universal system. In addition, the purpose of this invention is to offer an information processor, control method, and system that offers position information that can acquire error information anyplace at any time simply and can use this error information to improve the precision of position information by a system such as DGPS. Furthermore, the purpose of this invention is to offer an information processor, control method, and system that offers position information that can greatly reduce costs for equipping the environment required for using error information and can use position information that has high precision at low cost.

(Means of Solving the Problems) For this purpose, this invention is designed so that a service system that offers error information regarding position information can be accessed by way of a computer network. In addition, it is designed so that position information is corrected by error information obtained by way of a computer network, or position information corrected by appropriate error information is obtained by transmitting position information to a service system. That is, the information processor of this invention is so characterized that it has a position information acquisition means that can acquire its own position information based on data received from several satellites, an access means that can connect by way of a computer network to a service system that offers error information on the position information, and a

position information correction means that transmits the position information to the service system, receives error information for correcting the position information, and corrects the position information. In addition, the latter means can transmit position information to the service system and receive corrected position information.

Various means for accessing a computer network may be considered, and any communication medium network that can be used today or any communication medium network that can be used in the future can be accessed using the wired public telephone network as a matter of course, portable telephone circuits such as PHS, or media such as CATV networks. Furthermore, computer networks can handle data in common between various types of hardware and software by employing a common protocol. Today, the Internet, which uses the Internet (IP) protocol TCP/IP, covers roughly the entire world. By accessing the Internet using some sort of communication medium, open information on the Internet can be used freely by anyone. Therefore, when a service system is provided that offers error information by way of a computer network, the access means of the information processor of this invention can connect to a computer network by way of any medium that the information processor can use, and furthermore, can acquire error information easily by accessing the service system. As a result, because the information processor of this invention does not require limiting the communication medium used to acquire error information, it has high universality. In addition, because it can use any of various communication medium networks such as the public telephone network already provided in every region or various communication medium networks that may be equipped in the future as the

communication medium that connects to the computer network, it does not require installing a dedicated communication medium network for transmitting error information to the information processor, and has high future expansion capacity. Therefore, extremely few costs are required for equipping the environment to employ a system that corrects position information by error information such as DGPS.

Furthermore, by using a computer network that transmits data digitally, it can handle increase in the number of users acquiring error information. Because error information can be acquired by accessing the computer network from the communication medium access point that is closest and most convenient to the location of the user, communication expenses for acquiring error information are low.

Furthermore, instead of correcting position information by the information processor, position information can be acquired that has /4
been transmitted to the service system using a computer network and corrected using information such as data obtained from satellites, and the processing load on the information processor can be reduced. Therefore, this invention can be applied to small lightweight mobile information processors that are portable or automobile-mounted.

An information processor of this invention that has these types of functions can be realized by controlling an information processor that has a position information acquisition means that can acquire its own position information based on data received and an access means that can connect to a desired service system by way of a computer network by software that has the following control functions:

1. a function that acquires position information by the position information acquisition means,

2. a function that connects to a service system that offers error information on position information by the access means,

3. a function that transmits position information to the service system,

4. a function that receives error information for correcting position information from the service system or corrected position information.

This type of control method or software can be a recording medium such as a ROM, hard disk, or IC card, and can be offered by way of a computer network such as the Internet, or can be offered as an add-on or plug-in function for an information processor that has a position information acquisition means and an access means.

Furthermore, in this invention, because connection is made to a computer network that communicates bidirectionally, position information obtained by the information processor can be transmitted to the service system. Therefore, the service system can specify the user that is the recipient of error information and the location of the user. As a result, the service system can select or process error information that applies to the location of the information processor and transmit it to the information processor, or the service system can execute correction processing using the error information that applies to the position information. In addition, the fixed base station closest to the location of the user can be used as the service system. Furthermore, the fixed base station that becomes the service system also can be a system that acquires error information by updating the access address of the information processor to the next fixed base station as the user moves. Information on the user and the user's location can be stored in the

service system ahead of time.

As the error information applied to the location of the information processor, when a fixed base station is close to the location of the information processor, error information may be offered by this fixed base station. Alternately, a service can be used that, for example, offers the appropriate error information by processing error information from several fixed base stations. Thus, the system that offers position information of this invention is so characterized that it is a system offering position information that receives data showing position information from several satellites and can acquire error information from several fixed base stations that can offer error information on the position information by comparing it to its own preascertained reference position, and it has a means that stores the error information from the fixed base stations as reference error information, a means that receives the user position information by way of a computer network, and a position information offering means that selects or processes the error information that applies to the user position information from the reference error information and transmits this to the user by way of the computer network. In addition, the latter means may find the error information that applies to the user position information from the reference error information and correct the user position information, then transmit this to the user by way of the computer network.

This type of system that offers the position information of this invention does not require setting up countless base stations that have a function that generates error information such as systems that transmit error information from PHS base stations. In addition, it does not require that the information processor have functions such as a

function for selecting the PHS base station that offers appropriate error information. Therefore, by using the information processor and system that offers position information of this invention, a system can be constructed extremely inexpensively that can use position information that has high precision by correcting position information.

Furthermore, the service system of this invention is not limited to offering error information for correcting position information, but also can offer map information of the vicinity of the information processor or other information based on corrected position information with high precision to the information processor by way of a computer network. Information such as map information may be offered by the service system that offers error information, or map information can be offered by a different service system from the service system that offers error information. By providing a function in the information processor that connects by the access means to the above-mentioned map information service system that offers information such as map information, it becomes possible to acquire map information for the region pertaining to an accurate position based on corrected position information and to process this such as by displaying it.

(Working Examples) Below, a working example of this invention is explained referring to the figures. Figure 1 shows an example in which terminal (10) that can measure its own location by receiving radio waves from GPS satellites (1) is used as a working example of this invention. By receiving radio waves from the four lowest GPS satellites (1) simultaneously by independent GPS measurements, measurement coordinates of longitude B or b, latitude L or l, and height H or h can be found as position information. Therefore, the location of the information

processor can be found by executing GPS measurement by portable or mobile automobile-mounted information processing terminal (10) that /5 has GPS reception antenna (2) and a GPS measurement function. However, position information obtained by GPS measurement contains error due to error factors such as the ionosphere or the troposphere, and its precision by the bands and codes generally opened today is about 100 m. As a method for correcting such error factors, there is the method of finding error information from position information obtained for a reference position and using this to correct other position information. As a method for improving the precision of position information obtained by GPS measurement, a method called difference GPS (DGPS) is known that corrects using error information obtained from fixed base station (20) that has ascertained coordinates. For example, when measurement coordinates (B, L, H) are obtained from position information by GPS measurement at fixed base station (20a) that has reference coordinates (B0, L0, H0), coordinate error is (ΔB, ΔL, ΔH). Because this coordinate error fluctuates due to error factors, it varies according to the place and time GPS measurement is performed. Therefore, if information processing terminal (10) obtains measurement coordinates (b, l, h) in the vicinity of fixed base station (20a) at roughly the same time, it can correct these using coordinate error information (ΔB, ΔL, ΔH) and can calculate its location with good precision. In practice, by employing this type of DGPS system in a GPS, accurate coordinates for a location can be obtained at an error of several meters or less. However, the range within which error information obtained at fixed base station (20) can be applied is limited in DGPS to about several hundred km from fixed base station (20), and a system is required for transmitting

appropriate error information for an information processing terminal that has not ascertained its location.

Information processing terminal (10) of this example is designed so that it obtains appropriate error information at its location by connecting to Internet (30) that is one computer network. Therefore, it can obtain position information with high precision by using DGPS based on this error information. Figure 2 shows the schematic structure of information processing terminal (10) of this example. Information processing terminal (10) of this example is a portable terminal, and has a structure centered on CPU (11) that is a control unit. Memory (12) that is an internal memory device, display device (13) such as an LCD, input device (14) that can be inputted by keyboard or pen input, external memory device (15) such as a hard disk or floppy disk, and expansion bus interface (17) are connected to internal bus (16) connected to CPU (11). In addition, data communication device (18) is connected to internal bus (16). This data communication device (18) connects information processing terminal (10) to nearby Internet access point (30a) by way of the public telephone network or a PHS circuit network, and also is designed so that it can exchange data with a service server connected to the Internet following the TCP/IP protocol. In this example, data communication device (18) is an access unit that has a function that accesses particular service stations by way of the Internet. Furthermore, GPS surveyor (19) is also connected to internal bus (16). This GPS surveyor (19) has receiver (19a) that receives data from GPS satellites by way of GPS reception antenna (2), and calculator (19b) that finds position information such as coordinate position and time information by analyzing the data received. Terminal (3) is

installed in information processing terminal (10) of this example to allow mounting reception antennas other than housed GPS reception antenna (2).

An application program that uses a GPS function to find the location of information processing terminal (10) is provided in external memory device (15) of information processing terminal (10) of this example, and is designed so that it obtains the accurate coordinates of the location of information processing terminal (10) upon user operation or a command from another application. Figure 5 shows an example of control operation by an application program that finds location. When commanded to find location, the application program stored in this external memory device (15) is loaded in memory, and CPU (11) starts processing following the program. First, in Step 51, GPS surveying is executed using GPS surveyor (19). Next, in Step 52, connection is made to Internet (30) using data communication device (18). Furthermore, in Step 53, a connection to a service system is secured using the Internet address of service system (35) that offers error information for DGPS. Processing to confirm connection to service system (35) may be executed simultaneously with GPS survey processing, or, needless to say, GPS survey processing may be started after confirming connection to the service system. Next, in Step 54, position information containing coordinates and time information obtained by GPS surveying is transmitted to service system (35) by way of Internet (30). In Step 55, error information for the transmitted position information is received by way of the Internet, and in Step 56, information such as coordinates is corrected and displayed on display device (13). In addition to error information, map information also can be received from service system

(35), and map information for the location of the information processing terminal can be displayed on the display device with the location shown on top of the displayed map.

Moreover, in Step 55, instead of receiving error information, by acquiring position information with information such as coordinates already corrected, the processing load on information processing terminal (10) can be reduced. Furthermore, when GPS surveying is repeated periodically, error information can be procured by way of the Internet at constant survey intervals, and the processing time for procuring error information by way of the Internet can be shortened.

Figure 3 shows the schematic structure of fixed base station (20) that measures error information. In this example, this has GPS antenna (2) and GPS surveyor (21) that executes GPS surveying. GPS surveyor /6
(21) has receiver (21a) that receives radio waves from GPS satellites by GPS antenna (2), and calculator function (21b) that calculates error information (difference data) by comparing preascertained reference position information to the measurement information found from GPS satellites. Calculated error information (ΔB, ΔL, ΔH) is stored by the memory device of server (23), and is supplied by communication equipment (24) to service system (35) at set time intervals or continuously. In this example, fixed base station (20) also is designed to supply error information to service system (35) by way of the Internet, and there is no need to set up dedicated wireless equipment between fixed base station (20) and service system (35). Obviously, fixed base station (20) and service system (35) may be connected by a line such as a dedicated line or wireless line. In addition, because fixed base station (20) in this example is connected to Internet (30), it can be connected directly

to information processing terminal (10) by way of Internet (30). Therefore, as long as information processing terminal (10) knows the Internet address of an appropriate fixed base station (20) for itself, it also can acquire error information by using fixed base station (20) as a service system.

Figure 4 shows an example of service system (35). Service system (35) in this example has communication equipment (36) that connects to Internet (30), server (37) that manages information for a user accessing service system (35) by way of Internet (30), and service server (37) that supplies error information to the accessing user. From one to several of this type of service system (35) may be installed per wide region such as a country that can be recognized by users even without GPS surveying. In addition, the Internet address of the service system may be provided in information processing terminal (10) or the application program for GPS surveying operated by information processing terminal (10). Services of service system (35) in this region can be received by the user or the application program accessing the Internet by designating the Internet address of an appropriate service system. In addition, information processing terminal (10) is designed such that when it accesses service system (35), it also transmits the position information surveyed by GPS. As a result, when the location of information processing terminal (10) is outside the range of the service system (35) accessed, processing can be executed simply such as returning information from the service system (35) accessed to the information processing terminal as appropriate and accessing another system by information processing terminal (10).

When error information is procured by way of the Internet, position

information containing coordinates and time information obtained by GPS surveying is transmitted to service system (35). As a result, service system (35) can select the coordinate error of the fixed base station (20) closest to the coordinates of the user from among fixed base stations (20). Furthermore, because time information is appended, it can transmit error information obtained at the same time or correct position information using this error information. Therefore, by the information processor and system that offers position information of this invention, position information obtained by GPS surveying can be corrected to information that has still higher reliability and better precision.

Figure 5 shows one example of processing in service system (35). First, in Step 61, connection is made to service system (35). Alternately, error information that becomes a reference is acquired from several fixed base stations (20) within the service range of this service system (35) and stored in service system (35) together with time information. In addition, when accessed by a user by way of the Internet in Step 62, position information is received in Step 63. Next, this position information is analyzed and error information of an appropriate fixed base station is selected at the same time from the coordinates and time information obtained by GPS surveying. In Step 64, this error information is transmitted by way of the Internet. Needless to say, in Step 64, position information may be transmitted after correcting, or information such as map information pertaining to the position information can be transmitted to the information terminal of the user. In Step 65, service server (38) of this example stores information on the accessing user (such as user identification information) and position information, and for example, can be a service that offers this

position information to accessing users at times such as when asked to search for a lost child. In addition, this example is designed such that the error information of the fixed base station closest to the information processing terminal of the user is offered as error information, but needless to say, the service may also be designed to process the error information thought to be most appropriate for the location of the user from the error information of several fixed base stations and offer this to the user. Furthermore, it can be designed such that a fixed base station can be used as the service system by having the service system offer the Internet address of the fixed base station closest to the user. The service may also be designed to change the fixed base station and indicate the Internet address of the next fixed base station or service system as the user moves.

As explained above, in the system of this example that uses an information processing terminal that has a GPS surveying function, difference information —that is, error information —required for DGPS is obtained by way of the Internet, which is a computer network. This Internet itself is already constructed on a global scale, and access to the Internet can use various communication media such as wired or wireless telephone networks, PHS, or CATV. Furthermore, when an access point connected to the Internet is accessed by any of these communication media, a connection to a particular service system can be established by way of the Internet. Furthermore, it is considered that as information infrastructures are set up, it will become possible to access the Internet simply and inexpensively from more access points. Therefore, by supplying error information to individual information processing terminals by way of the Internet, as in the system with which

this invention is concerned, hardly any expense is required to construct a system that uses error information to improve the precision of position information, and DGPS can be used extremely inexpensively in any location. In addition, because an information processing terminal can acquire error information so long as it has a function that can connect to the Internet, there is no need to install communication equipment known as a dedicated PHS or FM in the information processing terminal, and error information or position information with high precision can be used by an information processing terminal that has high universality. Furthermore, by accessing a service system that communicates bidirectionally by way of the Internet, the service system can have the many functions and information described above and these functions can be used by the information processing terminal. Therefore, the many functions and information involved in GPS surveying can be obtained using small lightweight mobile information processors that are portable or automobile-mounted.

Moreover, an example was explained above that uses GPS satellites as the method for measuring the location of the information processing terminal, but this invention is not limited to GPS, and needless to say, can also be applied to cases that specify position by radio waves from other satellites. Furthermore, the Internet is considered to be the computer network that is cheapest and easiest to use today, but needless to say, this invention can be applied to any future network so long as it is a computer network that can be used universally.

(Effects of the Invention) As explained above, in the information processor and system that offers position information of this invention, error information for increasing the precision of position information

obtained from satellites is acquired by way of a computer network. As a result, there is no need to install a new communication system for offering error information, and an environment that can use high-precision position information such as DGPS can be offered extremely inexpensively. In addition, because position information measured by a means such as GPS can be transmitted to a service system by way of a computer network when obtaining error information, a multiplicity of services can be received as described above.

(Brief Explanation of the Figures)

Figure 1 is a schematic diagram that shows a system using an information processing terminal of this invention that houses a GPS survey function and obtains position information by way of the Internet.

Figure 2 is a block diagram that shows a structural example of the information processing terminal shown in Figure 1.

Figure 3 is a block diagram that shows a structural example of the fixed base station shown in Figure 1.

Figure 4 is a block diagram that shows a structural example of the service system shown in Figure 1.

Figure 5 is a flow chart that shows an outline of processing in the information processing terminal shown in Figure 1 and the service system shown in Figure 4.

(Key to Part Numbers)

1 ... GPS satellite

2 ... GPS antenna

10 ... information processing terminal

11 ... CPU

12 ... memory

13 ... display device

14 ... input device

15 ... external memory device

16 ... internal bus

18 ... data communication device (unit that access the Internet)

19 ... GPS surveyor

20 ... fixed base station

30 ... Internet

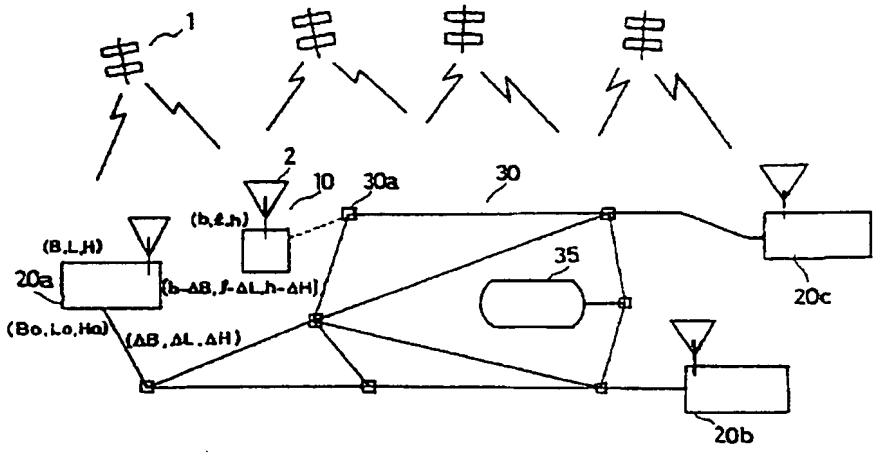
35 ... service system

36 ... communication unit (unit that access the Internet)

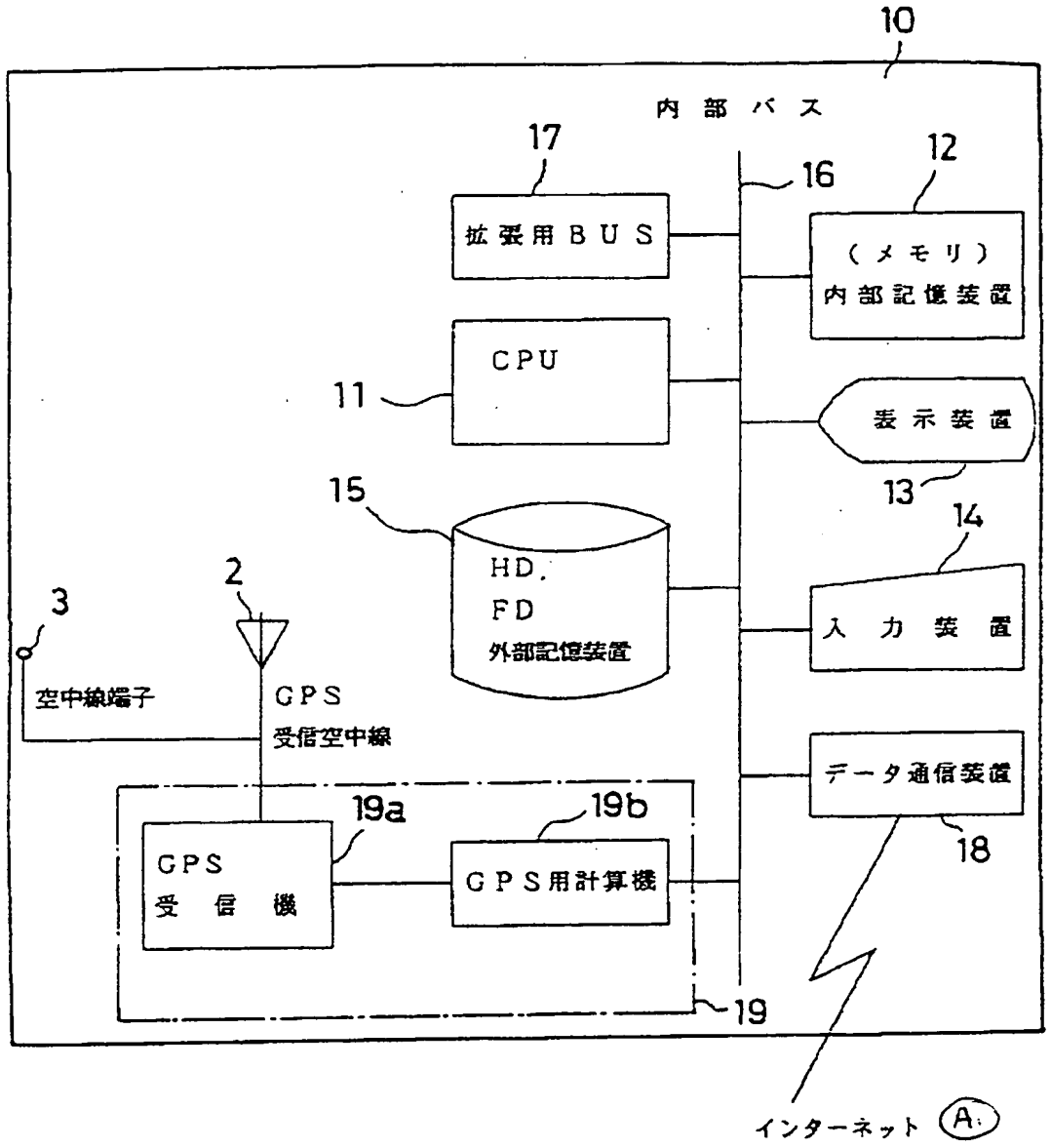
37 ... user management server

38 ... error information service server

10 mobile device
30 Internet
20 BS
35 service



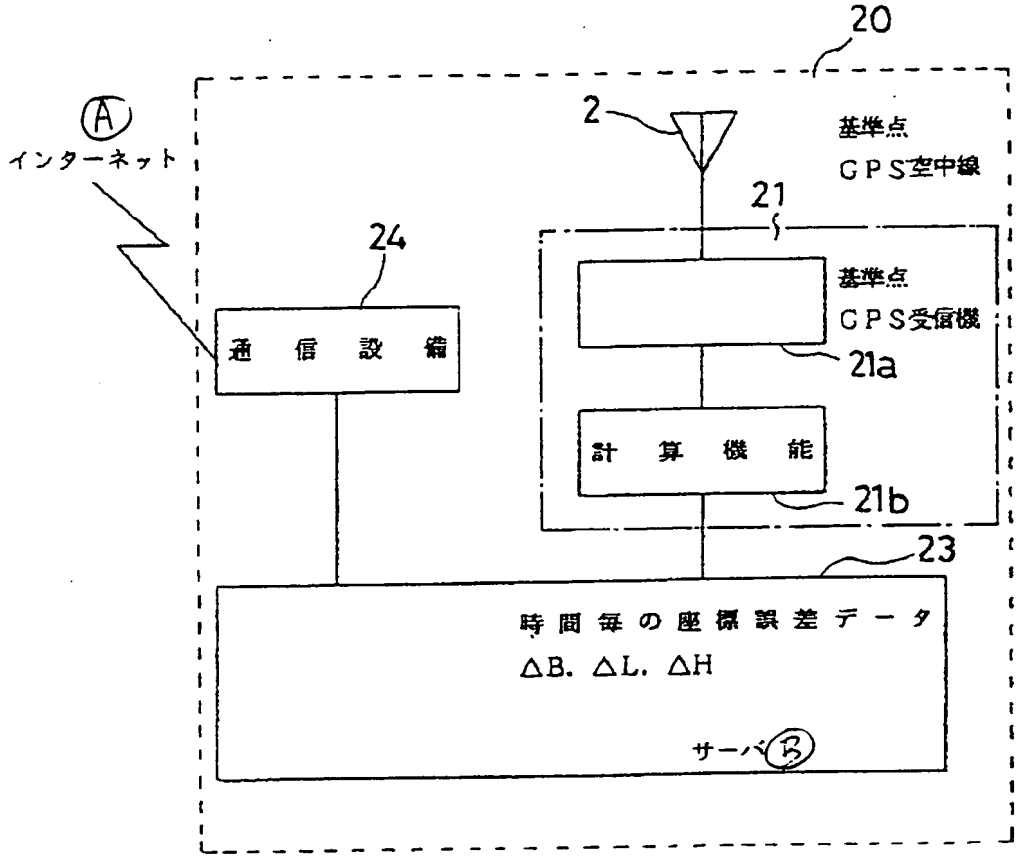
(Figure 1)



(Figure 2)

[Key:]

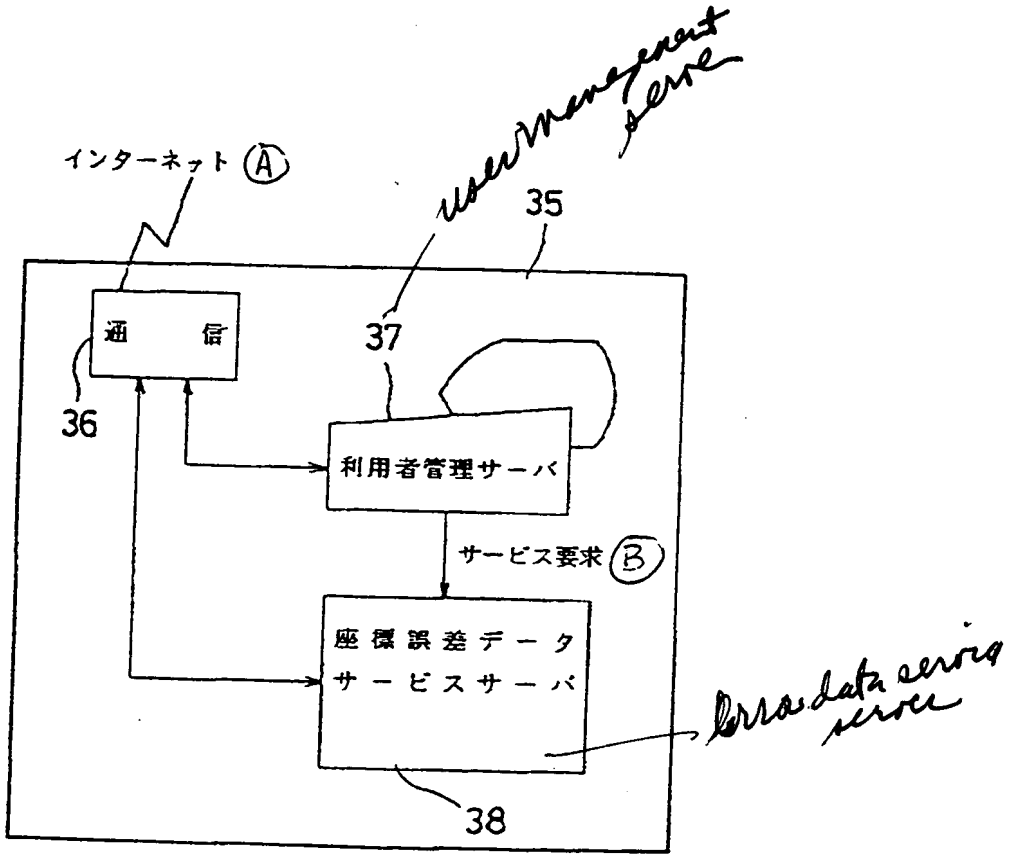
2 ... GPS reception antenna
3 ... antenna terminal
12 ... internal memory device (memory)
13 ... display device
14 ... input device
15 ... external memory device (HD or FD)
16 ... internal bus
17 ... expansion bus
18 ... data communication device
19a ... GPS receiver
19b ... GPS calculator
[A] ... Internet



(Figure 3)

[Key:]

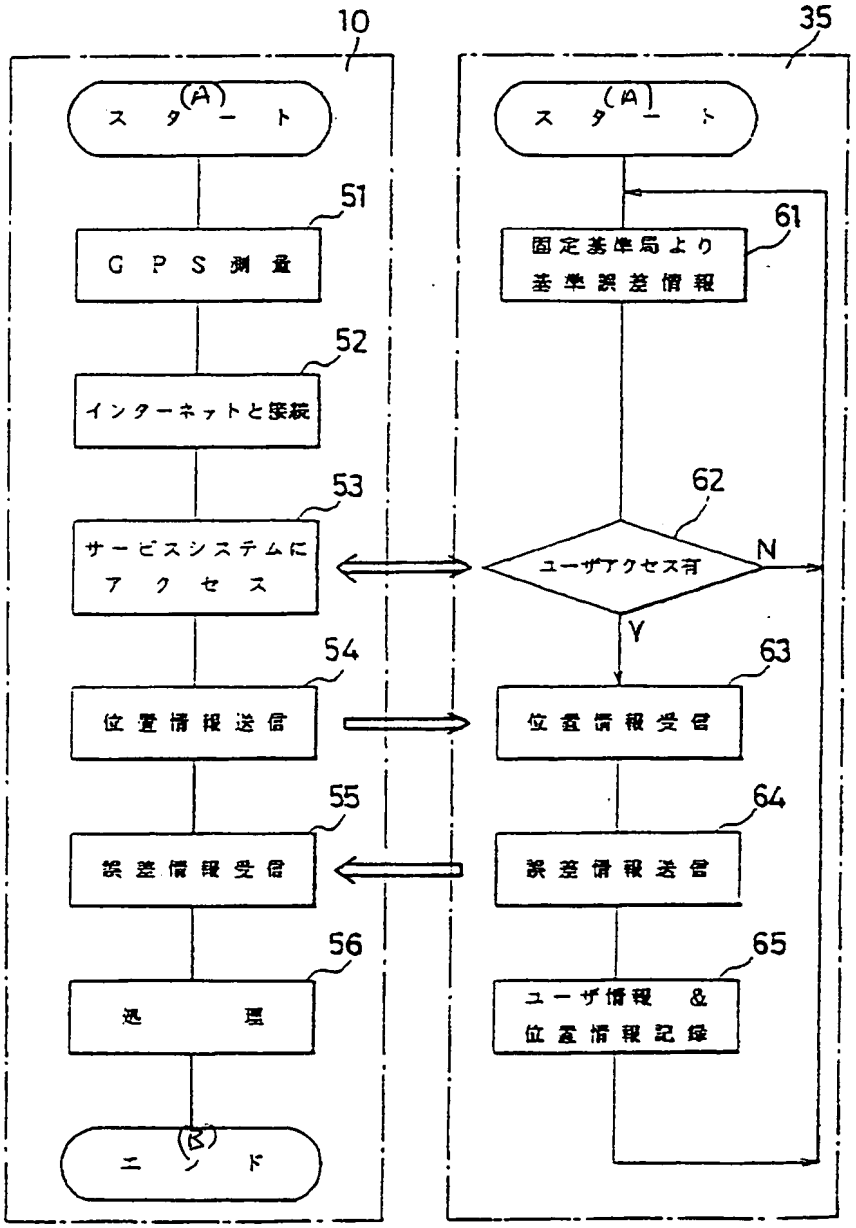
2 ... reference point GPS antenna
21a ... reference point GPS receiver
21b ... calculator function
23 ... coordinate difference data at each time
[B] ... server
24 ... communication equipment
[A] ... Internet



(Figure 4)

[Key:]

36 ... communication unit
37 ... user management server
38 ... coordinate error data service server
[B] ... service request
[A] ... Internet



(Figure 5)

[Key:]
[A] ... start
51 ... GPS survey
52 ... connect to Internet
53 ... access service system
54 ... transmit position information
55 ... receive error information
56 ... process
[B] ... end
61 ... reference error information from fixed base station
62 ... user access?
63 ... receive position information
64 ... transmit error information
65 ... store user information and position information